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ECS SS12943

SPACE SHUTTLE PROGRAM
Space Shuttle Projects Office (MSFC)
NASA Marshall Space Flight Center, Huntsville, Alabama

Reusable Solid Rocket Motor

STS-109 Flight Readiness Review/CoFR

Motor Set RSRM-83

14 February 2002

Presented by Terry Boardman

THIOKOL PROPULSION

P.O. Box 707, Brigham City, UT 84302-0707 (435) 863-3511

Agenda

Flight Readiness Review/CoFR

1.0 Previous Flight Assessment—STS-108

2.0 Certification Status—**No Constraints**

3.0 Changes Since Previous Flight—**None**

4.0 Configuration Inspection

- 4.1 As-Built Versus As-Designed, Hardware, and Closeout Photo Review Status—**No Issues**
- 4.2 Hardware Changeouts Since ET/SRB Mate Review—**None**

5.0 SMRB Nonconformances—**None**

6.0 Technical Issues/Special Topics

7.0 Readiness Assessment

Backup LCC and Contingency Temperatures for STS-109

Previous Flight Assessment—STS-108

Disassembly Evaluation Summary—Status of Disassembly Activity

KSC Operations		LH RSRM	RH RSRM	Remarks
Initial LH/RH SRB viewing	*	Complete	Complete	
SRB/RSRM walkaround assessment	*	Complete	Complete	
Demate/evaluate aft exit cone (AEC)	*	Complete	Complete	
Remove/evaluate S&A and OPTs	*	Complete	Complete	
Remove/evaluate nozzle	*	Complete	Complete	No nozzle throat pocketing
Remove/evaluate stiffener rings/stubs		Complete	Complete	
Remove/evaluate igniter	*	Complete	Complete	
Demate/evaluate field joints/evaluate insulation	*	Complete	Complete	
Utah Operations				
Disassemble/evaluate nozzle (joint No. 4 and 5)	*	Complete	Complete	
Disassemble/evaluate nozzle (joint No. 2 and 3)	*	Complete	Complete	
Disassemble/evaluate S&A	*	Complete	Complete	
Washout nozzle phenolics		Complete	Complete	
Washout nozzle AEC phenolics		14 Feb 2002	14 Feb 2002	
Measure/evaluate aft dome insulation		22 Feb 2002	22 Feb 2002	

* RSRM Project committed to complete prior to next launch

- **No constraints to STS-109 flight**

Technical Issues/Special Topics

O-ring Resiliency Reassessment

Observation

- Recent O-ring resiliency test data indicates previous test/extrapolated resiliency may not be conservative

Concern

- Challenge to baseline design certification to contract end item (CEI) 2X tracking requirement for O-ring seals

Background

- Field joint O-rings are required to track twice (2X) the maximum expected joint displacement (MED) at maximum expected operating pressure (MEOP)
  - MED following 1986 SRM redesign was established at 0.009 in. measured at land between primary and secondary O-ring grooves
  - Data obtained during redesign resiliency testing showed a minimum 16.5-percent O-ring compression (squeeze) was necessary to provide 2X tracking for 0.009-in. gap opening in 0.600-second ignition transient at 75°F

Technical Issues/Special Topics

O-ring Resiliency Reassessment (Cont)

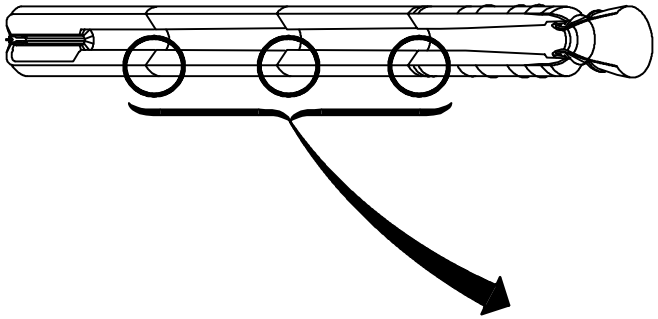
Background (Cont)

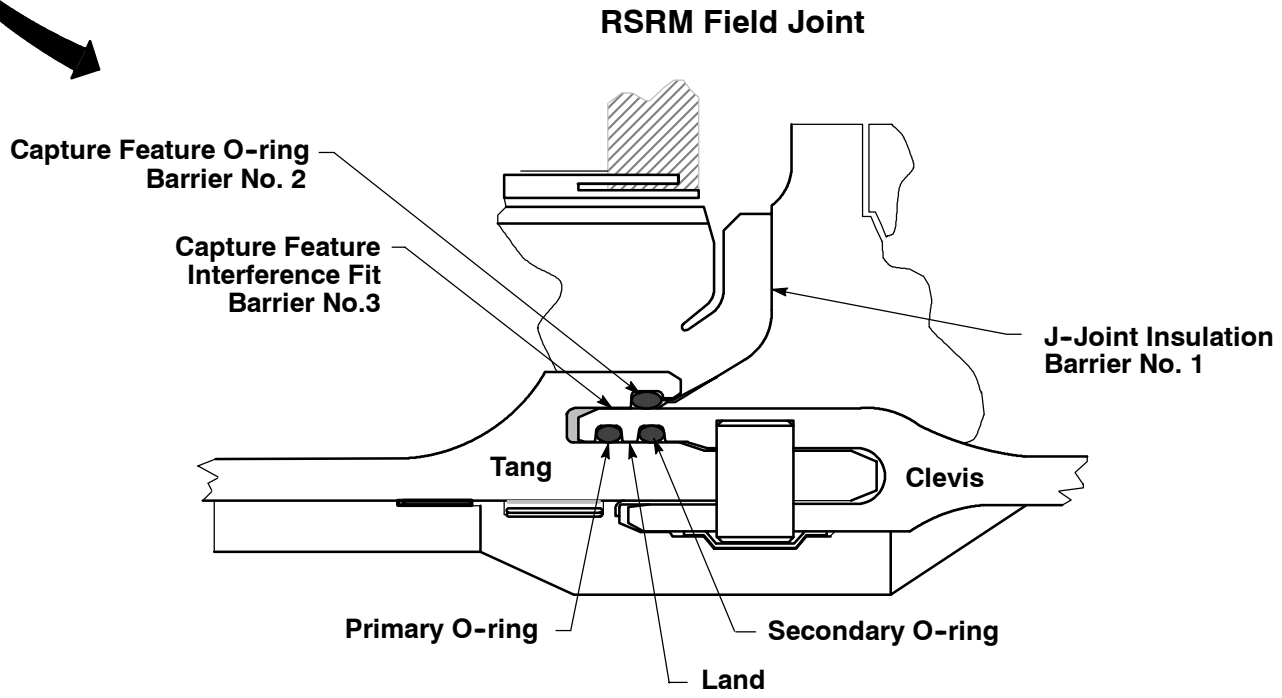
- Minimum O-ring squeeze was adjusted to 15.1 percent in 1993 to account for worst-case seal surface refurbishment. Certification baseline MED was adjusted to 0.0084 in. to ensure 2X tracking
  - RSRM project allowed use of data extrapolated from 16.5- to 15.1-percent squeeze to show 2X tracking
  - Current field joint launch commit criteria (LCC) temperature of 80°F is based on this extrapolation
- Recent experiments were conducted to verify validity of extrapolated data below 16.5 percent by obtaining tracking data at 10- and 14-percent squeeze levels
  - Data showed that the maximum gap opening that could be tracked at 2X with 15.1-percent squeeze was 0.0081 in. in 0.600 second—0.0003 in. less than the certification baseline MED of 0.0084 in.
  - Worst-on-worst case conservatisms for joint motion analysis show generic tracking factor falls from 2X to 1.94X

Technical Issues/Special Topics

O-ring Resiliency Reassessment (Cont)

Background (Cont)





Technical Issues/Special Topics

O-ring Resiliency Reassessment (Cont)

Discussion

- Worst-case field joint O-ring squeeze on STS-109 as-built motor set is 16.5 percent—flight hardware meets current generic certification requirements
  - Joint heaters are operated with 97°F setpoint ensuring O-ring temperatures greater than 90°F—well above 80°F LCC
  - If heaters fail, contingency temperatures based on as-built configuration and most recent resiliency data ensure 2X tracking requirement is met
- The following changes are necessary to address generic certification issue:
  - Effective STS-109
    - Waiver RWW0549 (one flight effectivity) to cover generic design not meeting CEI 2X tracking requirement at 80°F—waiver approved
  - Effective STS-110 and subsequent
    - LCC change to increase joint sensor temperature minimum to 86°F to account for new resiliency test data and ensure generic design certification to CEI 2X tracking requirement including MRB conditions
    - Generic certification paperwork update to document new resiliency test data and new generic field joint LCC temperature

Flight Rationale

- As-built configuration for STS-109 verifies O-ring seals meet 2X tracking requirement
- STS-109 is safe to fly

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STS–109 Readiness Assessment

Pending satisfactory completion of normal operations flow (per OMRSD), the RSRM hardware is ready to support flight for mission

STS–109

14 February 2002

/s/ T. A. Boardman

T. A. Boardman
RSRM Deputy & Chief Engineer
Thiokol

/s/ S. F. Cash

S. F. Cash
Chief Engineer, RSRM Project
NASA, MSFC

/s/ H. L. Reed

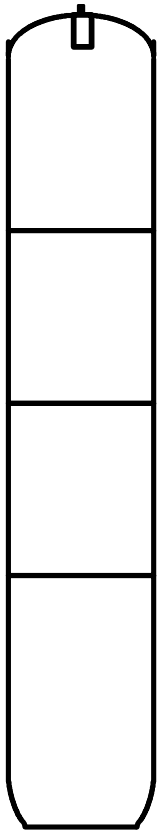
H. L. Reed
Director
RSRM Operations & Flight Support
Thiokol

/s/ M. U. Rudolphi

M. U. Rudolphi
Manager
RSRM Project Office
NASA, MSFC

Current Flight Predictions

LCC and Contingency Temperatures for STS-109



Heater Location	LCC	Minimum Allowable Sensor Temperature*	
		LH	RH
Igniter	74°F	72°F	72°F
Forward Field Joint	80°F	73°F	69°F
Center Field Joint	80°F	70°F	68°F
Aft Field Joint	80°F	64°F	71°F
Nozzle-to-Case Joint	75°F	65°F	63°F

*LCC contingency temperature in the event of heater failure
Note: Calculation includes all standard repair conditions including evaluation of Technical Issue (Section 6.0)